Toward Linking Seabed Stratigraphy and Nested Seismic Datasets in STRATAFORM: Finalizing Plans for Long Coring and Synthesizing Existing Physical Property Data

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LONG-TERM GOALS

The long-term goal of this project is to synthesize existing STRATAFORM data into forms that will serve a larger community and to further the existing goal of long coring within the STRATAFORM scientific framework. This final phase of synthesis and ground-truthing is critical for achieving the goals of the STRATAFORM program, as it represents the bridge between physical stratigraphic observations and seismic interpretations of depositional processes. As this award is on a January–January cycle, these results represent a mid-year progress report of this year's studies.

OBJECTIVES

The objectives of this work unit are twofold: 1) synthesize existing physical property and sedimentological data developed within the STRATAFORM program, as a robust synthesis of terrigenous sediment physical properties from continental margin environments has been lacking; and 2) prepare plans to ground-truth the nested resolutions of seismic data collected in the project by way of long-coring of the seabed, as these data image the resulting deposits formed by continental shelf sedimentary processes.

APPROACH

1) Calibration and Modeling of Physical Properties

Lee has analyzed cores collected during cruises on the Wecoma in 1995 (W9509A); the Melville in 1997 (M9707) and on the Wecoma in 1998 (W9807) with his MST logger, which generated values of gamma-ray density, seismic velocity and magnetic susceptibility. This dataset provides a unique opportunity to calibrate bulk physical and acoustic properties calculated from remotely sensed logger data with directly measured porosity and sediment texture. New relationships developed for the littoral zone from the extensive STRATAFORM databases provide more accurate modeling of seabed-acoustic interaction, given the variation in sediment types from the deep sea to the continental margin. Jeff Borgeld holds the largest porosity and grain size dataset for the shelf and I hold the data for the slope.

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14. ABSTRACT

The long-term goal of this project is to synthesize existing STRATAFORM data into forms that will serve a larger community and to further the existing goal of long coring within the STRATAFORM scientific framework. This final phase of synthesis and ground-truthing is critical for achieving the goals of the STRATAFORM program, as it represents the bridge between physical stratigraphic observations and seismic interpretations of depositional processes. As this award is on a January-January cycle, these results represent a mid-year progress report of this year's studies.

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2) Analysis of Cores Collected from the Marion Dufresne II on the New Jersey margin.

On a summer 1999 cruise to the New Jersey STRATAFORM area on the French RV *Marion Dufresne II*, 11 long cores were collected (longest core 37 m). No funds were allocated to analyze these cores after collection. This subproject will examine detailed sediment texture in the longer, more fine-grained of these piston cores, as a means of developing sampling protocols for the much larger number of NJ STRATAFORM cores to be collected and to develop information on distal clinoform development and lowstand offshelf transport that can be tied into the geophysical and modeling efforts by the New Jersey STRATAFORM group. The textural data will be combined with the whole-core logger data collected immediately after core collection on the ship and compared with the physical property correlations developed from the CA STRATAFORM area as described above.

3) Coordination and Planning for Deep Coring Activities

The long coring program is using the GLAD800 coring system and the New Jersey Natural Laboratory. Over the past four years, Greg Mountain and I, and more recently Jamie Austin have co-led the planning process for developing the strategies and targets for long coring in both the east and west coast STRATAFORM areas. During this funding year, a field test of the GLAD800 coring rig and its DURIP-funded active heave compensation system needs to be made and an additional planning meeting needs to be held with NJ STRATAFORM and GEOCLUTTER scientists (e.g., Austin, Goff, Sommerfield) to refine the location of proposed coring locations based on pre-existing and recently acquired seismic datasets. Should the test prove successful, I will be the co-Chief Scientist with Austin leading the core collection effort in the NJ study area on a KNORR cruise in September-October 2002, spending much of my funded time this year planning and coordinating the cruise participants and schedule.

4) Communication of Research Results

The communication and integration of results within interdisciplinary research programs is critical to gain the highest return from the time and money invested. Approachs to this objective include presentations at meetings, writing integrative papers to link shelf and slope results and participation in several chapters in the Master Volume. As new data is produced in this project, I will continue the migration of sediment information into ARCVIEW format so that it can be included in the STRATAFORM GIS database.

WORK COMPLETED

1) Empirical relationships between texture, porosity, bulk density, and sound velocity are being determined from the extensive dataset for use by modelers in their models of acoustic response and sediment properties. Lee has provided all logger data for the three cruises referenced above and existing sedimentological data have been received from Borgeld. Sommerfield and Wheatcroft have promised to send data. Nittrouer had no pertinent data. All holders of data have been queried at this time. I have incorporated all of Borgeld's and my directly measured data to produce a robust assessment of these relationships that covers the shelf and slope (Fig. 1, 2, 3). We are presently determining the best statistical methods for parameterizing these relationships. These relationships are similar to those derived earlier by Hamilton et al and detailed comparison with their empirical results with those from this study will be completed.

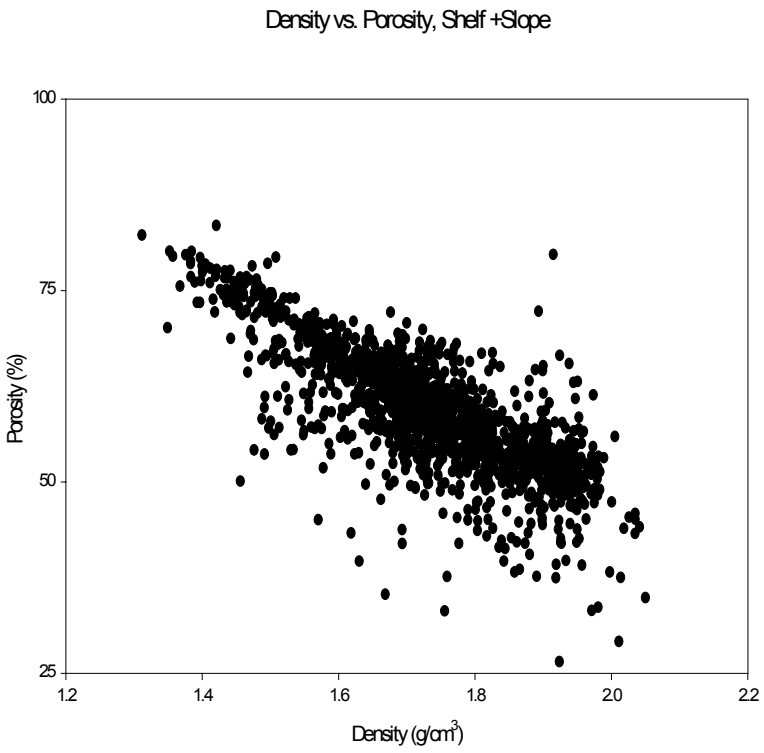

Figure 1: Density vs porosity relationship for shelf and slope cores. Density increases as porosity decreases

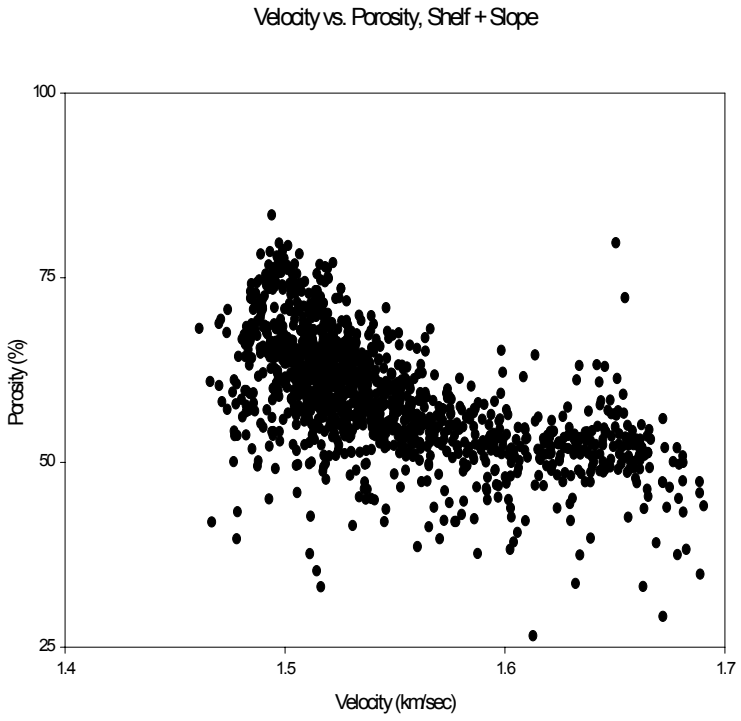

Figure 2: Seismic velocity vs porosity relationship for shelf and slope cores. Velocity increases non-linearly as porosity decreases.

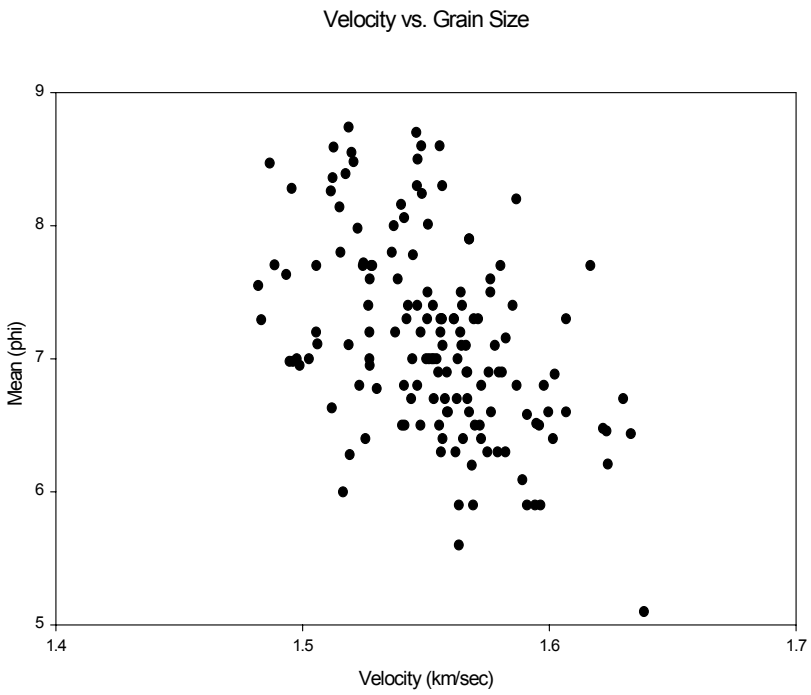

Figure 3: Velocity vs Grain Size relationship for slope cores. Velocity increases as grain size coarsens.

2) The longer, muddier cores collected from the *Marion Dufresne II* have been split, initially described at LDEO by Mountain and McHugh and reside in the ODP core repository. Core descriptions are in hand and have been used to develop a subsampling strategy which will be carried out in November. X-radiographs were produced for some core sections and these data are being acquired to better refine the intervals to be sampled.

3) In November 2001, I participated with Mountain and Austin in a successful test of the GLAD800 active heave compensation system on the RV KNORR and participated in a post-cruise assessment meeting at the Fall AGU. The core site selection meeting was held at UTIG (where the bulk of the pertinent seismic data reside) on July 29-31, 2002. The KNORR is on schedule to be used for the long-coring cruise from 27 September to 18 October 2002.

4) I am participating in two of the STRATAFORM Master Volume chapters (3 and 4). A paper reporting the long-term slope accumulation patterns in relation to sea-level history is in preparation. My GIS database, which is constantly being updated, now includes station locations, accumulation rates for long and short cores, grain size, porosity and aerial extent of depositional regimes.

RESULTS

Empirical relationships are presently being determined for the extensive datasets acquired through the STRATAFORM program. There are obvious inverse relationships between velocity vs grain size, density vs porosity and velocity vs porosity. Different relationships exist for the shelf and slope, indicating that these two sub-environments probably will need to be treated separately to gain the

greatest use from this data. The successful test of the heave-compensated GLAD800 system in November 2001 demonstrates the capability to take long cores on continental margins within reasonable budgetary constraints.

IMPACT/APPLICATIONS

The full impact/applications of these results are yet to be determined. The physical property relationships will have great application to NAVY acoustic modeling efforts.

TRANSITIONS

None as the results are not yet ready for dissemination.

RELATED PROJECTS

H. Lee is working with the geotechnical data that I am using, providing additional insight into their significance. J. Locat has analysed Marion Dufresne cores for geotechnical properties and desires core material from the KNORR cruise for similar analyses. Austin has GEOCLUTTER funding to participate in the KNORR cruise and a student who will use this project as a datasource for her PhD.

REFERENCES

none

PUBLICATIONS

None. I am presently contributing to two Master volume chapters.

PATENTS

none